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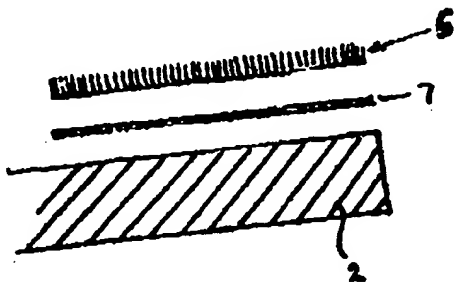
(57) Abstract

An artificial turf comprises a first carpet layer (1), a second layer (2) and a third, intermediate, adhesive layer (7). The adhesive layer (7), is characterised by comprising a hot–melt adhesive having an adhesion and shear strength, at normal temperatures which are sufficient to cause that layer to restore its resting condition if the first and second layers are partially dislocated by an impact force applied tangentially to the first layer during use of the artificial turf. This resistance to distorsion allows the artificial turf to recover from most accidental strikes, e.g. by clubs, boots, bats etc. during sporting use.



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Artificial Turf

The present invention relates to artificial turf, and more particularly to artificial turf on which ball games can be played.

It is known to construct artificial turf having a synthetic textile sheet, composed of fibres, intertwined such that the fibres project from a first ("top") surface of synthetic textile sheet to form a pile. A closed-cell foam-backing layer, typically composed of polyurethane or polyethylene foam, may be provided on the other ("bottom") surface of the synthetic layer textile layer. In use, the foam-backing layer provides a resilient base to the artificial Turf. To laminate the layers together an adhesive may be provided, and/or the polyurethane foam may penetrate through the fibres of the textile layer to partially encapsulate the fibres.

Artificial turf finds many uses in situations whereas real grass cannot be grown and/or maintained adequately. Nevertheless, there remain disadvantages with the known systems, principally where games such as hockey soccer golf, are concerned, in which a ball is struck from the surface.

The action of striking a ball from the surface of an artificial turf can cause large frictional and reaction forces to be transmitted to and through the artificial turf, in addition to any direct impact of the striker in the case of a mistrike. There remains a recognised need for artificial turf's which can resist and/or recover from such forces and their associated heating and destructive effects, while not resisting to such an extent as to be a danger to users.

The present invention has as an objection the provision of and improved or at least alternative artificial turf in which the above problem is at least partially solved

According to a first aspect, therefore, the present invention provides an artificial turf comprising;

(a) A first, carpet, layer comprising a synthetic sheet having a first ("top") surface and a second ("bottom") surface, the sheet comprising fibres of synthetic grass, intertwined such that fibres project from the first surface to form a pile;

(b) A second , backing layer comprising a resilient elastromeric sheet extending over the second surface of the first layer to provide in use a resilient base for the artificial turf; and

(c) A third, intermediate, adhesive layer comprising a resilient synthetic thermoplastic adhesive with substantial resistance to ultra violet light;

Wherein the adhesive and shear strength of the third layer at normal temperatures are sufficient to cause that layer to restore its resting condition if the first and second layers are partially dislocated by an impact force applied tangentially to the first layer during use of the artificial turf.

The expression "tangentially" refers to a striking force Applied substantially across the first (carpet) layer, such as typically occurs in sporting use of an artificial turf, e.g. a strike by a boot, bat or club.

The expression "fibres" refers to any elongated form, for example yarns, filaments, strips etc. The cross-sectional configuration may, for example, be biconvex, rhomboid or diamond shape, particularly in the case of fibres that form the pile of the first layer.

The fibres of the first layer are suitably formed into the required sheet in the conventional manner, typically by weaving (e.g. Wilton or Axminster weaving in the manner of conventional –textile carpets), knitting (e.g. lockstitch or raschel knitting), tufting or as a needlefelt. The fibres are suitably formed of a relatively high melting point synthetic material, such a polyester or a polyamide (e.g. Nylon), which will suitably have a softening point of at least about 150c, more preferably greater than about 200c. It is important that the fibres of the first layer should have high strength and durability, and preferably a resistance to fibrillation or fraying, The first layer should be at least as strong as the adhesive bond between it and the adhesive, third, layer, to prevent tearing of the first layer in use.

The fibres of the first layer may suitably be hydrophilic to some extent.

The fibres which form the face yarn of the carpet, i.e. project to form the pile, are preferably about 300 to about 3000um wide and sufficiently long to form pile about 1 to2 cm deep. Those fibres are suitably dark green in colour, like healthy real grass.

The first layer is preferably constructed in a knitted arrangement using up to three different fibres, whereby the fibres are knitted together in a mesh consisting of lock and face yarns, from which the face yarn fibres extend to form the pile. The lock yarn is suitably composed predominantly of polyamide being intertwined in the mesh and projecting out to form the pile it is preferred the lockstitch knitting is used. Knitting machines such as200-inch wide flat bed Rachel knitting machines (such as those conventionally used to manufacture Astroturf ® carpet layers) may conventionally be used, the result is a carpet which, looking from the top, appears as a uniform lawn of artificial grass and, looking from the bottom, appears as a mesh or substantially square grid of intertwined fibres, with lines of knitted bundles of fibres linked by bridging fibres. Such as carpet is muti-directionally resilient.

It is generally preferred that the first layer is constructed in an open mesh way that freely allows liquids to pass through its structure without substantially reducing its grab tear strength. The first layer suitably has a fibre face weight of less than about 2000 g/m2, typically less than about 1800 g/m2, more preferably less than about 1500g/m2, and still more preferably about 1400g/m2 where the artificial turf is to be used in the game of golf, for example as a golf driving practise mat or as part of a golf course, the fibre face weight of the first layer may be reduced to between about 1300g/m2, for example about 1000g/m2, to better accommodate tee pegs, which some golfers like to use.

The materials of the first layer suitably incorporate conventional ultra-violet stabilising agents, which protect the materials against the materials against rapid degeneration under ultra-violet (UV) light. Suitable UV stabilising agents include Tinvin 200 and antioxidants. It is preferred that the materials of the first layer are substantially free of heavy metals, for environmental reasons when the artificial turf is disposed of.

For additional security against disintegration of the first layer in use, a absolute minimum anchor coating of conventional latex may conveniently be provided on the second surface of the first layer. A suitable latex is polyurethane containing a mineral filler such a chalk.

The second layer is typically at least about 1 cm thick, preferably between about 1 and 3 cm thick. It is suitably formed of a moulded elastromic material such as a synthetic rubber or closed-cell foam. The synthetic rubber may, for example, be a conventional styrene-butadiene rubber (SBR), such as is conventionally used for making Mobil tyres, or ethylene propylene diene monomer (EPDM) rubber. The closed- cell foam may, for example, be conventional polyurethane. Polyethylene or polyvinyl-chloride-nitrile foam. It is preferred that the material of the second layer will have a softening point of at least about 100c and a melting point of at least 150c, more preferably greater than about 200c.

The second layer is typically porous, thereby providing a waterproof resilient base for the artificial turf. It may be formed, for example, by moulded setting/curing of a liquid or semi-liquid starting material or of a particulate starting material in a settable matrix under suitable condition. As far as a liquid or semi-liquid starting material is concerned, the conditions will be readily chosen by one of the ordinary skill according to the nature of the starting material. As far as a particulate starting material is concerned, this may be for example be in the form of shreds or granules of rubber (so-called "crumb"), held together by a suitable resilient settable/ curable matrix such as a cross-linking resin (e.g. curable polyurethane or curable isocyanate / polydol) or by heating sintering.

The second layer should be at least as strong as the adhesive bond between it and the adhesive, third, layer, to prevent tearing of the second layer in use.

The weight of elastomeric particulate material in the second layer may vary widely. Typically, layers formed from particulate rubber held together by a curable cross-linking elastomeric matrix will contain between about 300 to about 1500kg rubber particles per m3, more preferably between 400 and about 1000 kg/m3. Where shreds of rubber are used, which are generally less preferably than crumb, the rubber weight

will be towards the top of these ranges; where crumb rubber is used, the rubber weight will be towards the bottom of these ranges, e.g. between about 400 and about 700kg/m3.

The crumb granules from which the second layer may be formed are suitable between about 1 and about 5 cm across and of generally round to elliptical shape. The Preferred crumb size is between about 1 and about 3 cm. The binding matrix material is preferably a curable two-component system having an a-component and a b-component whereby the and b components cure together by cross-linking. The matrix preferably does not include plasticizers or other water-soluble components, as these can be washed out by exposure of the artificial turf to rain, leading to cracking of the second layer.

The second layer is suitably prepared by thoroughly mixing the particulate rubber with enough of the a- and b- components to fully coat each particle. The mixture is then pressed in a mould at an elevated temperature (e.g. at least 80c) for sufficient time (e.g. at least about 4 minutes to cause the a and b components to cure and bind the rubber particles. The second layer should suitably be flexible and sufficiently soft that a golf tee peg or the like can be inserted into it by hand.

The second layer may be suitably be provide with one or more surface and/or internal voids and/or insert of other materials, to modify the resilience of the second layer as desired for the particular intended use of the artificial turf. For example, the surface of the second layer which faces away from the first layer (i.e. the under surface in use) may be provided with a depression, which may optionally receive an insert of different (e.g. greater) elasticity than the second layer material itself. Such an insert may, for example, comprise a closed-cell elastmeric foam such as polyethylene or polyethylene copolymer foam, having a density less than about36 kg/m3.

If the second layer is so modified, it can be possible to impart so-called "week spots" to or more particular region of the artificial turf, depending on the game to be played on it. By providing an air filled or foam-filled void in the side of the second layer, an elastic "bridge" exists across the void, which can respond to a tangential striking force in a manner similar to, or better than, real turf. Depending on the particular

arrangement employed, and the effects desired, the second layer may be reinforced, at least in the region above and adjacent to the void. Such reinforcement may, for example, be accomplished by using a plastic reinforced member, adjacent to or within the second layer, which may suitably be formed of a flexible, relatively strong, material such as extruded polypropylene, polyurethane or polyamide (e.g. Nylon ®).

The third (adhesive) layer is a synthetic thermoplastic adhesive to which a UV stabilising agent has preferably been added to prevent or restrict degradation under UV light. Hot-melt adhesives are preferred. Such adhesives are desirably pressure sensitive. The adhesive may suitably compromise an amorphous polyolefin, such as a tactic polypropylene or polybutene; a block copolymer based on aromatic and/or olefin monomers. Such as styrene-butadiene-styrene (SBS) or styrene-isoprene-styrene (SIS) block copolymers, or an ethylene-vinyl acetate (EVA) based adhesives. The adhesive is preferably non-hydroscopic and substantially free of any hydroscopic ingredients.

As indicted above, the adhesive third layer has an adhesion and shear strength at normal temperatures (generally about 5 to about 30c) such the first and second layers will substantially recover their mutual alignment after impact force which disturbs said alignment during use of the artificial turf.

More particularly, the third layer should have a relatively high tack (immediate adhesion), to cause high adhesive bond strength to both the first and the second layers. It is preferred that the tack of the adhesive of the third layer, as measured on glass, should be at least about 20N/25mm, more preferably at least about 30 N/25mm. In the test, a standard 25 x 25 mm (625mm3) area of adhesive, transfer-coated onto a 50mm thick polyethylene terephthalate substrate cut into a 25, wide strip, at a coverage of 40 g/m2, is applied briefly to the horizontal glass sheet and the pull-off force measured. The area applied to the glass is the front part of an advancing loop of the substrate (adhesive outwards).

A further measurement of adhesion, more particularly longer-term adhesion, is the resistance of an adhesive to 180 degrees peeling away from a vertical test surface such as glass. It is preferred that the peel force of the adhesive of the third layer, as

measured on glass, should be at least about 20 N/25mm, more preferably at least about 30 N/25mm 20 minutes after application to the glass. In the test, the adhesive is coated onto the 25mm wide substrate as described above. The adhesive is then applied to the glass, left for 20 minutes for the adhesive bond to develop, and then the force needed to peel the 25mm wide strip straight back on itself (180 degree peel) measured via a tensometer.

The third layer should have relatively high shear strength, to provide for the resilient deformation which is a feature of the present invention. In a convenient standard shear test, a square test area (substrate conditions described above) of 625 mm2 is applied to a vertical glass surface and a 1 kg weight hung from the substrate. The time taken for the weight to fall is the shear time of the adhesive. It is preferred that the shear time of the adhesive of the third layer, as measured by the above standard shear test, should be greater than about 15 hours at 50 c, more preferably greater than about 20 hours, and greater than about 5 hours at 70 c, more preferably greater than about 10 hours.

The adhesive of the third layer will suitably also be resistant to heat. More particularly, it should have a softening point of at least about 80 c.

It is preferred that the third layer comprises the hot-melt block copolymer adhesive DURO-TAK H2036 E (national starch & chemical limited, Slough, UK). This adhesive has a softening point of about 122 c; viscosity characteristics of about 70 Pa.s (150c), about 36 Pa.s (160c) and about 10 Pa.s (180c) using a Brookfield Thermosel Sp 27, 20 rpm, viscometer; tack of about 39n/25 mm measured as described above; 180 degrees peel of about 40 N/25 measured as described above; and the shear times of greater than 24 hours at 50c and greater than 10 hours at 70c measured as described above.

The second backing layer extends over the second surface of the first (carpet) layer. Moreover, the second layer can be made larger than the first layer so that the first layer provides an artificial turf mat located on a larger base composed of the backing layer. Such an arrangement is particularly suitable, for example, for practise mats whereby sports people can practise striking a ball, e.g. a golf or cricket ball. The

person can stand on the backing layer and the ball can be placed on the artificial turf mat or on a tee or other mounting device engaging with the artificial turf, prior to be struck.

The artificial turf according to the invention is suitably prepared by bonding together performed first and second layers, using a suitable adhesive to form the intermediate bonding third layer.

The adhesive may be applied either as a hot melt, or at sub-molten temperature. When sub-molten temperatures are used, the adhesive is conventionally applied as a sheet of the desired thickness in a transfer-coating process. The adhesive sheet is initially provided with a peelable release sheet (e.g. of silicone-coated paper or the like) on each side. A first release sheet is removed and the exposed side of the adhesive sheet brought into contact with one of the first and second layers. The second release sheet is then removed and the newly exposed side of the adhesive brought into contact with the other of the first and second layers.
It is preferred that the above described cold application is used, followed by pressing at elevated temperature (e.g. above about 100c), to constitute a cold and hot process. The resultant bonding has been found to be better than in the case of hot-malt application. Further more, the thickness of the third (adhesive) layer of the artificial turf can be controlled better than in the case of the hot-melt initial application of the adhesive. It is preferred in the present invention that the thickness of the adhesive layer should be as constant as possible, within tolerances of preferably about 15% at most, so that the properties of the turf are constant across the full extent of the playing surface.

It is most preferred that the adhesive layer in the artificial turf of the present invention should be greater than about 0.5 mm in thickness, preferably greater than about 0.1 mm, representing an adhesive load of greater than about 0.5 Kg/m2, preferably greater than about 0.1 Kg/m2, in the artificial turf. It has been found, suprisingly, that a relatively thick, even, layer of adhesive provides the advantageous properties found in the present invention, even though it would have previously been expected that the bond strength would suffer as a result of the relatively thick application of adhesive.

The preferred bonding method is of more general applicability and constitutes itself a second aspect of the present invention.

According to a second aspect, therefore, the present invention provides a method for manufacturing of an artificial turf, comprising;

(a) Providing a first, carpet, layer comprising a synthetic sheet having a first ("top") surface and a second ("bottom") surface, the sheet comprising fibres of synthetic grass, intertwined such that fibres project from the first surface to form a pils;

(b) Providing a second backing, layer comprising a resilient elastromeric sheet;

(c) Applying to one of the said first and second layers a third, adhesive layer comprising a synthetic thermoplastic hot-melt adhesive, at a temperature below the softening point of the adhesive;

(d) Contacting the other of the said first and second layers with the third layer, so that the third layer is intermediate the first and the second layers;

(e) Pressing the first and second layers together, optionally at an elevated temperature.

It is preferred that the first, second and third layers are as described above in connection with the first aspects of the invention. The application steps © and (d) are preferably carried out as transfer coating steps by preparing (suitably by molten casting) a sheet of the adhesive coated on both major surfaces, with peelable release sheets. E.g. of silicone paper or the like and removing the release sheet one at a time for each step.

The pressing step (e) is preferred performed at a temperature of at least about 100c, for a period of at least 1-minute.

For further illustration of the present invention, and to show how the same may be put into practice, an embodiment will now be described, without limitation and purely by way of example, with reference to the accompanying drawings in which:

Figure 1 shows a perspective view of an artificial turf golf practice mat;

Figure 2 shows a vertical cross-section along the line 2 –2 of figure 1, looking in the direction of the arrows, with the parts of the mats shown separated for clarity;

Figure 3 shows a corresponding vertical cross-section through an alternative golf practise mat;

Figure 4 shows an enlarged side view of the carpet ("grass") of the golf practice mat of figures 1,2 and ;

Figure 5 shows an enlarged plan view of the underside of the carpet of figure 4.

Referring to the drawings, there is shown generally an artificial turf golf practice mat comprising artificial grass carpets 1 at each end of a base 2, to cater for left and right handed golfers.

Each carpet 1 comprises a synthetic sheet of generally open mesh construction formed of two general types of fibres 3,4 intertwined in a knitted arrangement such that some of the fibres project from the top surface of the carpet to form a pile 5.

The first type of fibre 3 is a polypropylene yarn, which may typically be uncoloured or lightly coloured. The second type of fibre 4 is a polyamide (nylon) yarn, which is typically dark green and may have a biconvex or diamond cross-section . The fibres are knitted together by a conventional Rachel Knitting machine, to achieve the arrangement shown particularly in figures 4 and 5, in which the underside for the carpet has the appearance of a square grid arrangement of lightly coloured lock yarns 3, intertwined with which are the dark green face yarns 4 which project out of the knitted sheet to form the pile5 of the carpet.

The underside of the carpet is typically coated with a thin latex anchor coat (not shown), in generally conventional manner, to further strengthen the integrity of the knit.

The base 2 is formed of a resilient elastomeric sheet, which supports the carpets 1 and provides an area 1 on which the golfer stands. The elastomeric sheet is formed of press-moulded styrene-butadiene rubber crumb in a resilient polyurethane matrix.

The base 2 may optionally include an insert 6 of a softer resilient material such as closed-cell polyethylene foam (see figure 3), or may alternatively (not shown) include an air void in place of the insert. This softens the central region of carpet 1 above the insert, which can be advantageous in certain circumstances.

As shown separated in figure 2 and 3 for clarity, the base 2 and the carpet 1 layers are bonded together via an intermediate adhesive layer 7. The adhesive is chosen from resilient synthetic thermoplastic adhesives which provide an adhesion and shear strength of the adhesive layer 7 at normal temperatures sufficient to cause that layer to restore its resting condition if the carpet 1 is partially dislocated from the base 3 by impact force applied tangentially to the carpet, for example on striking of the carpet by a golf club. The preferred adhesive is duro-tak H2036 E (national starch & chemical limited, slough, UK), the properties of which have been described above. The adhesive layer 7 is preferably relatively thick, preferably greater than about 0.2mm.

The golf practice mat can be made by any conventional bonding process using materials having the required properties as already described . Most preferably, the surface of the base 2 or the under surface of the carpet1, using conventional silicone paper or the like, then the other part1 or 2 is contacted with the adhesive so that the adhesive is between the two parts, and subsequently the arrangement is pressed at an elevated temperature to bond the parts together.

It has been found that performance of the artificial turf according to the present invention is substantially improved, compared with known artificial turf. More particularly , the new artificial turf is robust, durable, weather-resistant and restore

its integrity without breaking or delaminating as a result of tangential impacts during use.

The foregoing broadly describes the invention without limitation to the particular example or embodiments. Variations and modification as will be readily apparent to those of skill in this art are intended to be included in the scope of this application and resulting patent (s).

Claims

1. An artificial turf comprising:

(a) A first, carpet, layer comprising a synthetic sheet having a first surface and a second surface, the sheet comprising fibres of synthetic grass, intertwined such that fibres project from the first surface to form a pile;
(b) A second backing layer comprising a resilient elastomeric sheet extending over the second surface of the first layer to provide in use a resilient base for the artificial turf.
(c) A third, intermediate, adhesive layer comprising a resilient synthetic thermoplastic adhesive.

Wherein the adhesion and shear strength of the third layer at normal temperatures are sufficient to cause that layer to restore its resting condition if the first and second layers are partially dislocated by an impact force applied tangentially to the first layer during use of the artificial turf.

2. An artificial turf according to claim 1, in which the fibres of the first layer are formed of a material selected from polypropylene, a polyester or polyamide.

3. An artificial turf according to claim 1 or 2, in which the first layer has a fibre face weight of less than about 2000 g/m2.

4. An artificial turf according to any one of the preceding claims, in which the second layer is formed of a synthetic rubber or a closed-cell foam.

5. An artificial turf according to claim 4, in which the synthetic rubber is styrene-butadiene rubber and the second layer is formed of particles of rubber in a resilient settable/curable matrix.

6. An artificial turf according to claim 5, in which the particles of styrene-butadiene rubber are present in the matrix in an amount of between about 300 and about 1500 kg/m3.

7. An artificial turf according to any one of the preceding claims, in which the second layer is provided with one or more surface and/or internal voids and/or inserts of other materials, to modify the resilience of the second layer.

8. An artificial turf according to any of the proceeding claims, in which the third layer comprises an amorphous polyolefine, a block copolymer base on aromatic and/or olefin monomers, or ethylene-vinyl acetate based adhesive.

9. An artificial turf according to claim 8, in which the third layer has a glass tack and peel of at least about 30 N/25mm, and shear times of greater than about 20 hours at 50c and greater than about 5 hours at 70c, using standard test procedures.

10. A golf practise mat comprising an artificial turf according to any one of the preceding claims.

11. A method for the manufacture of an artificial turf as defined in claim 1, the method comprising:

(a) providing a first, carpet, layer comprising a synthetic sheet having a first surface and a second surface, the sheet comprising fibres of synthetic grass inter-wind such that fibres project from the first surface to form a pile;
(b) Providing a second, backing layer comprising a resilient elastomeric sheet;
(c) Bonding the said first and second layers together by means of a third, intermediate, layer so that the second layer extends over the second surface of the first layer;

Wherein the bonding is such that the adhesion and shear strength of the third layer at normal temperatures are sufficient to cause that layer to restore its resting condition if the first and second layers are partially dislocated by an impact force applied tangentially to the first layer during use of the artificial turf.

12. A method for the manufacture of an artificial turf ,comprising:

(a) Providing a first, carpet, layer comprising a synthetic sheet having a first surface and a second surface, the sheet comprising fibres of synthetic grass, intertwined such that fibre project from the first surface to form a pile;
(b) Providing a second, backing , layer comprising a resilient elastromeric sheet;
(c) Applying to one of the said first and second layers a third, adhesive, layer comprising a synthetic thermoplastic hot-melt adhesive, at a temperature below the softening point of the adhesive
(d) Contacting the other of the said first and second layers with the third layer, so that the third layer is intermediate the first and second layers;
(e) Pressing the first and second layers together optionally at an elevated temperature.

13. An artificial turf, substantially as herein described with reference to figures 1,2,4 and or figures 1,3,4 and 5 of the accompanying drawings.

14. A golf practise mat, substantially as herein described with reference to figure 1,2,4 and 5 or figures 1,3,4 and 5 of the accompanying drawings.

15. A method for the manufacture of an artificial turf, substantially as herein described with reference to figures 1,2,4 and 5 or figures 1,3,4 and 5 of the accompanying drawings.

Fig.1

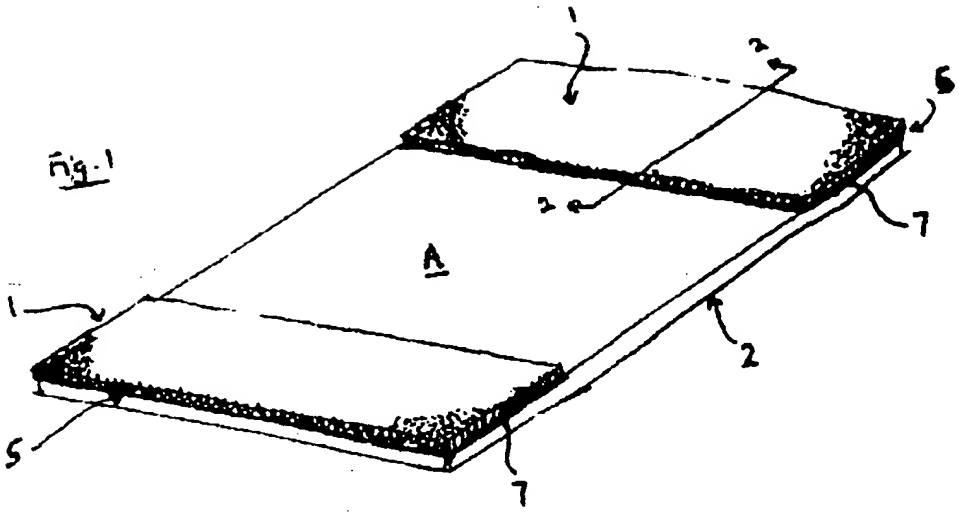


Fig.2

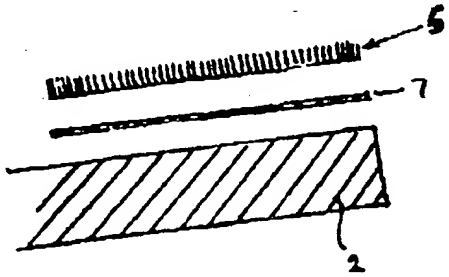


Fig.3

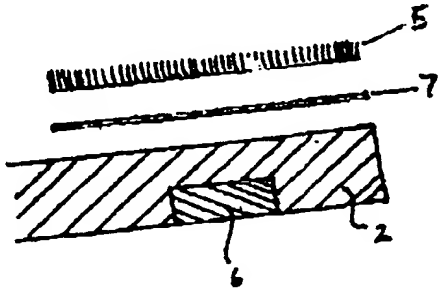
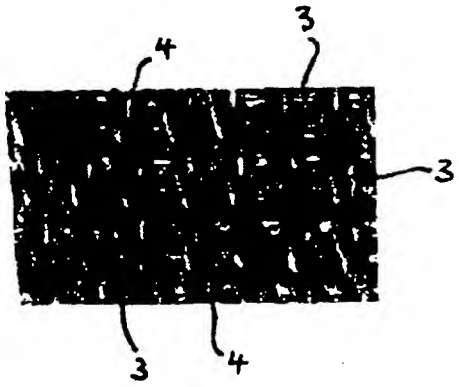


Fig. 4

Fig. 5



INTERNATIONAL SEARCH REPORT

Int tional Application No
PCT/GB 98/03624

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 E01C13/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 E01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 397 129 A (CHEVRON ERDOEL GMBH) 2 February 1979 see the whole document	1-5, 10-15
A	CH 625 098 A (FORBO-TEPPICHWERKE) 15 September 1981 see the whole document	1,2, 10-15
A	DE 32 04 215 A (GFL SPORTSTAETTENBAU GMBH) 18 August 1983 see the whole document	1,2, 10-15
A	FR 2 633 844 A (MAZET ROBERT) 12 January 1990 see the whole document	1,2,4, 10-15

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
30 March 1999	08/04/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Dijkstra, G

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INTERNATIONAL SEARCH REPORT

Int. ional Application No
PCT/GB 98/03624

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 576 665 A (MACHELL GREVILLE) 18 March 1986 see the whole document -----	1,4,8, 10-15

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Int tional Application No
PCT/GB 98/03624

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Fig.1

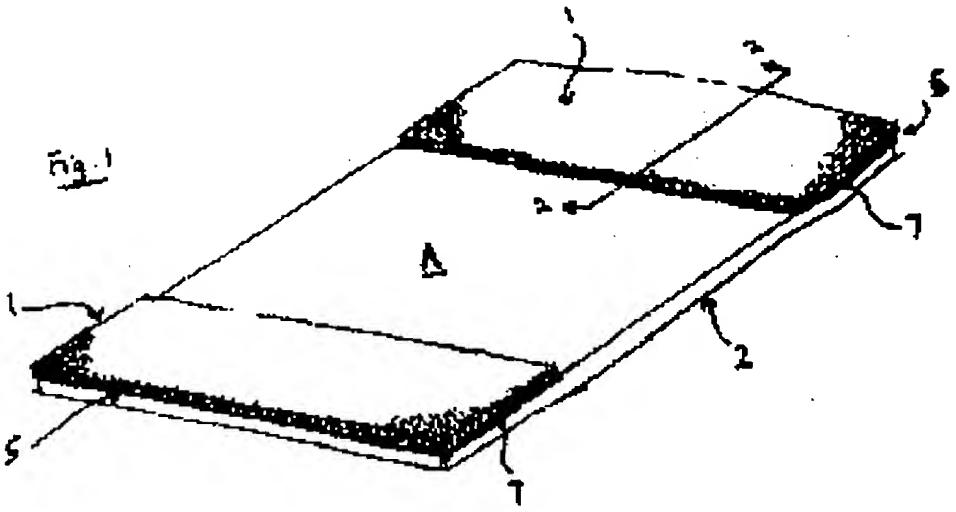

Fig.2

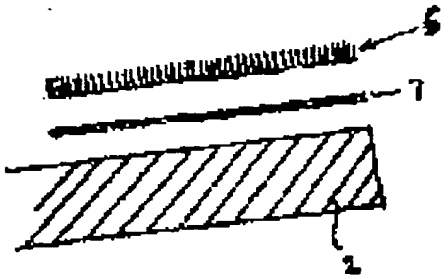

Fig.3

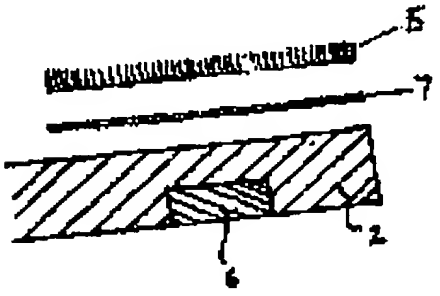

Fig. 4

Fig. 5